IS 6489-4 (2011): Textiles -- Tear Properties of Fabrics, Part 4: Determination of Tear Force of Tongue-Shaped Test Specimens(Double Tear Test) [TXD 1: Physical Methods of Tests]

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ISO 13937-4 : 2000

भारतीय मानक

वस्त्रादि — वस्त्रों के विदरण के गुण

भाग 4 जिव्हा के आकार के नमूनों का विदरण बल ज्ञात करना
(दोहरे विदरण परीक्षण द्वारा)

(दूसरा पुनरीक्षण)

Indian Standard

TEXTILES — TEAR PROPERTIES OF FABRICS

PART 4 DETERMINATION OF TEAR FORCE OF TONGUE-SHAPED TEST SPECIMENS (DOUBLE TEAR TEST)

(Second Revision)

ICS 59.080.30

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NEW DELHI 110002

December 2011 **Price Group 6**

Physical Methods of Test Sectional Committee, TXD 01

NATIONAL FOREWORD

This Indian Standard (Part 4) (Second Revision) which is identical with ISO 13937-4 : 2000 'Textiles — Tear properties of fabrics — Part 4 : Determination of tear force of tongue-shaped test specimens (Double tear test)' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Physical Methods of Test Sectional Committee and approval of the Textile Division Council.

This standard was first published in 1971 and subsequently revised in 1993. This standard has been revised again to align it with the latest version of ISO 13937-4 : 2000 by adoption under dual numbering system. Since ISO 13937 has been published in four parts, this standard has also been published in four parts. Other parts in this series are:

Part 1 Determination of tear force using ballistic pendulum method (Elmendorf)
Part 2 Determination of tear force of trouser-shaped test specimens (Single tear method)
Part 3 Determination of tear force of wing-shaped test specimens (Single tear method)

The conditioning temperature of 20 ± 2°C as specified in International Standards is not suitable for tropical countries like India where the atmospheric temperature is normally much higher than 20°C. It is almost impossible to maintain this temperature specially during summer when the atmospheric temperature rises even up to 50°C. In view of the above, IS 6359 : 1971 'Method for conditioning of textiles' which specifies a temperature of 27 ± 2°C for conditioning of the test specimens for the tropical countries like India shall be referred.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard with the above deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.
b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 139 : 2005 Textiles — Standard atmospheres for conditioning and testing	IS 6359 : 1971 Method for conditioning of textiles	Technically Equivalent
ISO 10012 : 2003 Measurement management systems — Requirements for measurement processes and measuring equipment	IS/ISO 10012 : 2003 Measurement management systems — Requirements for measurement processes and measuring equipment	Identical

(*Continued on third cover*)

Indian Standard

TEXTILES — TEAR PROPERTIES OF FABRICS

PART 4 DETERMINATION OF TEAR FORCE OF TONGUE-SHAPED TEST SPECIMENS (DOUBLE TEAR TEST)

(Second Revision)

1 Scope

This Part of EN ISO 13937 describes a double-tear method known as the tongue test, using a test specimen with cuts shaped to form a tongue. The tear force measured is the force required to propagate the previously started double tears when the force is applied parallel to the cuts and the fabric tears in the direction of the applied force.

The test is mainly applicable to woven textile fabrics. It may be applicable to fabrics produced by other techniques, e.g. to some nonwovens (with the same under-mentioned restrictions as for the woven fabrics).

In general the method is not applicable to knitted fabrics and woven elastic fabrics.

The method only allows the use of constant-rate-of-extension (CRE) testing machines.

NOTE 1: For other tear test methods using tensile-testing machines part 2 of EN ISO 13937 describes a method known as trouser test and part 3 a wing test method. Part 1 of EN ISO 13937 describes the ballistic pendulum (Elmendorf) method.

NOTE 2: For the trapezoidal test methods see ISO 9073-4 for nonwovens or ISO 4674 for coated fabrics.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 139 Textiles - Standard atmospheres for conditioning and testing

ISO 7500-1 Metallic materials - Verification of static uniaxial testing machines - Part 1: Tensile testing machines

ISO 10012-1 Quality assurance requirements for measuring equipment - Part 1: Metrological confirmation system for measuring equipment

3 Terms and definitions

For the purposes of this part of EN ISO 13937 the following terms and definitions apply:

3.1 constant-rate-of-extension (CRE) testing machine: Tensile- testing machine where one clamp is stationary whilst the other is moving with a constant speed throughout the test and where the entire testing system is virtually free from deflection.

3.2 gauge length: Distance between the two effective clamping points of a testing device.

NOTE: The effective clamping points (or lines) of jaws can be checked by clamping a test specimen under defined pretension with carbon copy paper to produce a gripping pattern on the test specimen and/or jaw faces.

3.3 tear force: Force required to propagate a tear initiated under the specified conditions.

NOTE: The tear force is qualified as "across warp" or "across weft" according to whether the tear is made across the warp (warp threads are torn) or weft (weft threads are torn) respectively.

3.4 peak: Point on a force/extension curve where the gradient, relative to the force values recorded, changes from positive to negative.

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NOTE: For tear recordings, a peak to be used for calculation is defined by rising and falling of force of at least 10 % of the last decreasing or increasing force value respectively.

3.5 length of tear: Measured distance propagated by a tearing force from the initiation of the force until its termination.

3.6 tongue-shaped test specimen: Strip of fabric in which parallel cuts of defined distance and length are made to form a tongue for clamping (see figures 1, 2 and 3).

4 Principle

Two parallel slits, connected by a slit at right angles to form a tongue are cut in a rectangular test specimen. The tongue is inserted in one jaw of a recording tensile-testing machine and the remaining part of the test specimen is clamped symmetrically in the other jaw to ensure both cuts each form straight parallel lines (see figure 3). A pulling force is applied in the direction of the cuts to simulate two parallel tears. The force to continue both tears over a specified length of tear is recorded. The tear force is calculated from the force peaks of the autographic trace, or on-line by electronics means.

5 Sampling

Select samples either in accordance with the procedure laid down in the material specification for the fabric, or as agreed between the interested parties.

In the absence of an appropriate material specification an example of sampling of a suitable sampling procedure is given in annex A.

An example of a pattern for cutting test specimens from the laboratory sample is given in annex B. Avoid test areas with folded or creased places, selvedges and areas not representative of the fabric.

6 Apparatus

6.1 General

The system for metrological confirmation of the tensile testing machine shall be in accordance with ISO 10012-1.

6.2 CRE machine, having the following characteristics:

a) Capable of operating at a constant-rate-of-extension of (100 ± 10) mm/min;

b) capable of gauge length to be set to 100 mm ± 1 mm;

c) provided with means for recording the force applied to the test specimen during the tear test;

d) under conditions of use, the accuracy of the apparatus shall be class 1 of ISO 7500-1. The error of the indicated or recorded maximum force at any point in the range in which the machine is used shall not exceed ± 1 %, and the error of the indicated or recorded jaw separation shall not exceed ± 1 mm;

e) if recording of force and extension is obtained by means of data acquisition boards and software, the frequency of data collection shall be at least 8 per second.

If a class 2 tensile testing machine has to be used, this shall be stated in the test report.

6.3 Clamping device, comprising the two jaws of the machine, the central points of which are in the line of pull, the front edges at right angles to the line of pull and the clamping faces in the same plane.

The jaws shall be capable of holding the test specimen without allowing it to slip and designed so that they do not cut or otherwise weaken the test specimen.

The width of the jaws shall preferably be 200 mm, but shall not be less than the width of the test specimen.

6.4 Equipment for cutting out test specimens, preferably a hollow punch or template to give test specimens of the dimensions shown in figure 1.

7 Atmosphere for conditioning and testing

The atmospheres for preconditioning, conditioning and testing shall be as specified in ISO 139.

8 Preparation of test specimens

8.1 General

From each laboratory sample two sets of test specimens shall be cut, one set in the warp direction and the other in the weft direction.

NOTE: For other than woven fabrics, use the relevant designation for direction e.g. length and transverse.

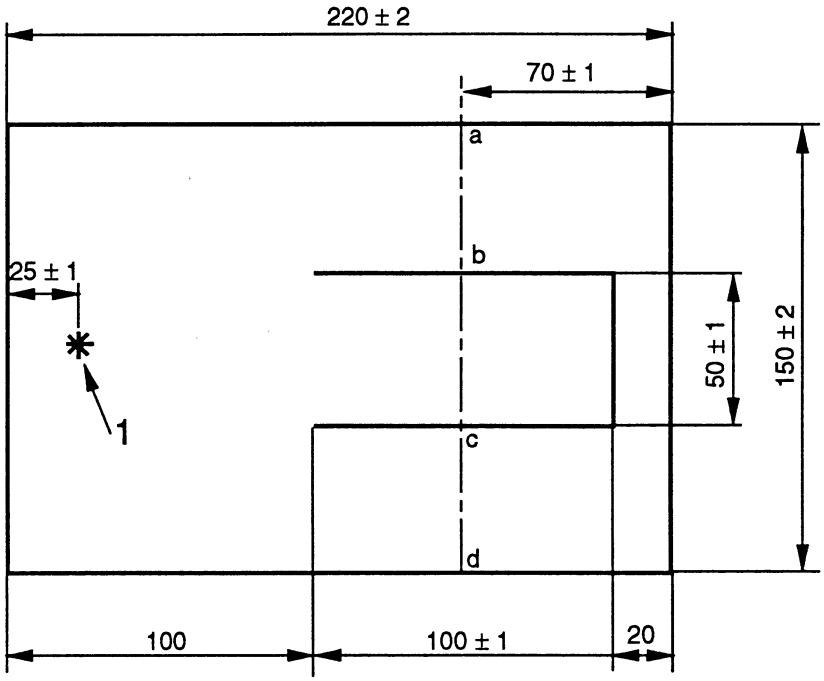
Each set shall consist of at least five test specimens, or more if agreed. In accordance with clause 5 and annex B, no two test specimens shall contain the same longitudinal or transverse threads, and no specimen shall be cut within 150 mm of the edge of the fabric.

8.2 Dimensions

Cut out test specimens in accordance with the shape and dimensions shown in figure 2 and mark the line abcd on both sides of each specimen. Mark the end of tear (25 ± 1) mm from the uncut end in the middle of the strip to indicate the position of the tear at the completion of the test.

Figure 1 - Example of tongue-shaped test specimen

Dimensions in millimetres



1 Mark for end of tear length

Figure 2 - Dimensions of tongue-shaped test specimen

8.3 Cutting out of test specimens

For woven fabrics, each test specimen shall be cut with its longer side parallel to the warp or the weft of the fabric. For test specimens where the longer side is parallel to the warp, the direction of the tear is qualified as "across weft" and for test specimens where the longer side of the test specimen is parallel to the direction of the weft the tear is qualified "across warp" (see 3.3 and annex B).

9 Procedure

9.1 Gauge length

Set the gauge length of the tensile testing machine to 100 mm.

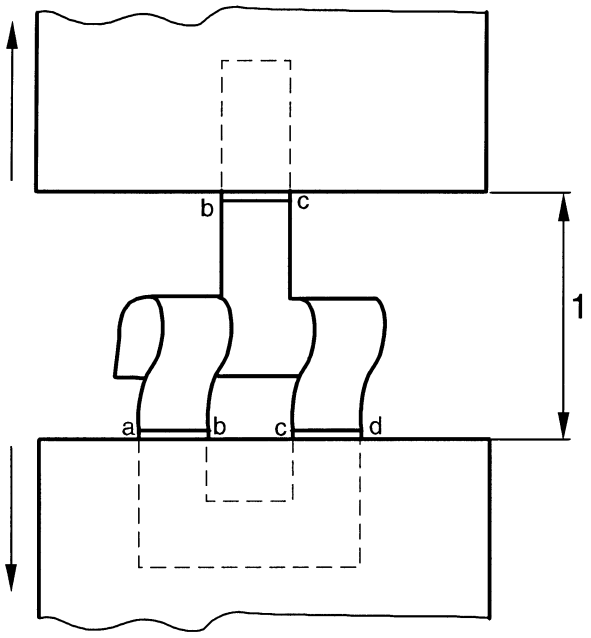
9.2 Rate of extension

Set the rate of extension of the tensile testing machine to 100 mm/min.

9.3 Mounting of test specimens

Clamp the tongue of the test specimen centrally and symmetrically in the fixed jaws so that line bc is just visible, as illustrated in figure 3. Clamp the legs of the test specimen symmetrically in the traversing jaws of the machine so that the lines ab and cd are just visible and the legs of the test specimen are parallel to the force of tear. Take care to ensure that each tongue is fixed in a jaw so that the beginning of the tear is parallel to the direction in which the tearing force is applied. Avoid pretension when the test is started.

Dimensions in millimetres



1 Gauge length (reduced during mounting)

Figure 3 - Clamping arrangement

9.4 Operation

Engage any device for recording of the tear force. Put the moving clamp in motion and continue both tears to the point marked near the end of the strip.

Record the tear force in newtons, and if a tear trace is wanted, record the the accompanying jaw separation (tear length) for each of the test specimens in each fabric direction, using recording or electronic devices (6.2).

If the evaluation of the peaks derived from dense fabrics with large numbers of threads per cm are to be taken from the chart recording manually (see 10.1), the speed of the chart paper has to be set to 2:1 in relation to the rate of extension speed.

Observe whether the tears proceed along the direction of force and whether any threads slip out from the fabric rather than being torn. The test is correct if there is a) no slippage of threads out of the fabric, b) no slippage in the jaws, c) the tear is completed and proceeded along the direction of application of the force. Other results shall be discarded.

If the results from three or more out of the five test specimens have to be rejected, the method is unsuitable.

If agreed test additional test specimens, preferably doubling the number of test specimens. In such cases, the reporting of the results shall also be agreed.

If the tear does not proceed along the direction of the cuts or threads are pulled out rather than being torn, the fabric shall be described as untearable in that direction by this test.

10 Calculation and expression of results

Two methods of calculation are specified, manual and electronic. They may not lead to the same result and results calculated by different methods are not to be compared.

10.1 Manual evaluation of tear forces from the chart recording.

For a sample of calculation see annex C.

10.1.1 Divide the tear length, beginning with the first peak and ending with the last peak recorded, into four equal parts (see annex C). The first part shall not be used for the calculation of the mean value. From each of the three remaining subsections, select and note the two highest and the two lowest peaks. A peak suitable for calculation is characterized by a 10 % min. rising and fallilng of force (see 3.4).

10.1.2 For each test specimen, calculate the arithmetic mean in newtons of the 12 peak values obtained according to 10.1.1.

NOTE: For manual evaluations a limited number of selected peaks is chosen to keep calculation time acceptable. For calculation including all peaks, electronic evaluation is recommended.

10.1.3 From the mean calculated for each test specimen (see 10.1.2) calculate the overall arithmetic mean of the tear force in newtons for each direction tested, and round it to two significant figures.

10.1.4 If required calculate the coefficient of variation to the nearest 0,1 % and the 95% confidence limits in newtons rounded to two significant figures, using the mean test specimen values as calculated according to 10.1.2.

10.1.5 If required, calculate the mean of the six heighest peak values in newtons for each test specimen.

10.1.6 If required, note the highest and the lowest peak value in newtons (maximum peak distance) for each test specimen.

10.2 Calculation using electronic devices

For a sample calculation see annex C.

10.2.1 Divide the tear length between the first and last peak recorded into four equal parts (see annex C). Ignoring the first part of the tear length, all peaks of the remaining distance are recorded. A peak suitable for calculation is characterized by a 10 % min. rising and falling in force (see 3.4).

10.2.2 The arithmetic mean in newtons for the test specimen is calculated using all peaks recorded according to 10.2.1.

10.2.3 From the mean calculated for each test specimen (see 10.2.2) calculate the overall arithmetic mean of the tear force in newtons for each direction tested, and round it to two significant figures.

10.2.4 If required, calculate the coefficient of variation to the nearest 0,1 % and the 95% confidence limits in newtons rounded to two significant figures, using the specimen mean values as calculated according to 10.2.2.

11 Test report

The test report shall include the following information:

11.1 General information

a) Reference to this part of EN ISO 13937 and the date of test;

b) identification of test sample and if required, sampling procedure;

c) number of test specimens and number of tests rejected and reasons for this;

d) observations on unusual tear behaviour;

e) whether mean values are calculated manually (see 10.1) or by electronic device (see 10.2);

f) any deviation from the given procedure.

11.2 Test results

a) The overall mean tear force across warp and across weft, in newtons. If only 3 or 4 test specimens are torn correctly, state the results for the individual test specimens;

b) if required, the coefficient of variation, in percent;

c) if required, the 95% confidence limits, in newtons;

d) if required, in case of manual evaluation (see 10.1), the mean of the maximum peak force values for each test specimen (see 10.1.5), in newtons;

e) if required, in case of manual evaluation (see 10.1), the lowest and highest peak force value for each test specimen (see 10.1.6), in newtons.

Annex A

(informative)

Suggested procedure for sampling

A.1 Bulk sampling (Number of pieces taken from a shipment or lot)

Take at random from the shipment or lot the appropriate number of pieces shown in table A.1. Ensure that no piece that shows signs of damage or dampness incurred during transit is included in the bulk sample.

Table A.1 - Bulk sampling

Number of pieces in shipment or lot	Number of pieces comprising bulk sample, minimum
3 or less	1
4 to 10	2
11 to 30	3
31 to 75	4
76 or more	5

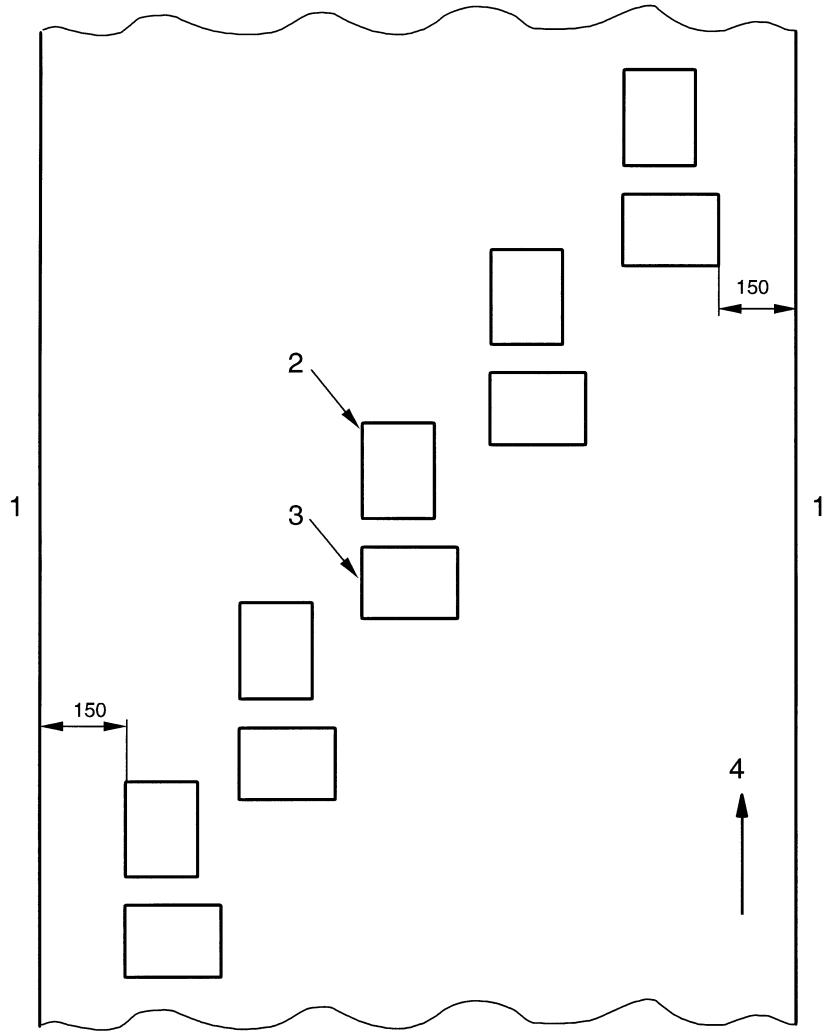
A.2 Number of laboratory samples

From each piece in the bulk sample, cut (from a position taken at random but at least 3 m from an end of the piece) a laboratory sample of length at least 1 m and of full width. Ensure that areas that are creased or that have a visible fault, or faults, are not included in the laboratory sample.

Annex B

(informative)

Example of pattern for cutting out test specimens from the laboratory sample



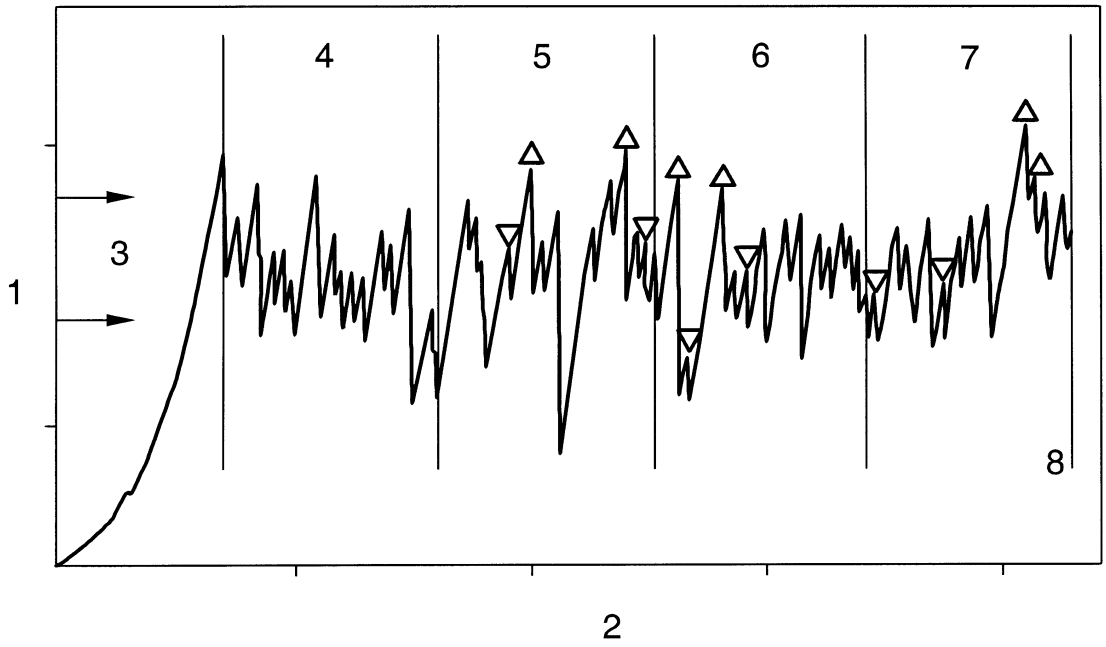
1 Edge
2 Specimen for tear "across weft"
3 Specimen for tear "across warp"
4 Warp

Figure B.1

Annex C

(informative)

Sample calculation of tear force



1 Force
2 Direction of tear (trace length)
3 Approx. medium peak range
4 Ignore
5 Subsection 1
6 Subsection 2
7 Subsection 3
8 End of tear

Figure C.1

Approximation of a peak (see 3.4).

For ease of handling manual evaluations, it is suggested to approximate the peak force level for medium height peaks from the tear trace of a test specimen. One tenth of this value, rounded to within about ±10 %, indicates the rising and falling in force required for characterization of a peak.

Example	Medium-height peaks	85 N to 90 N (approximate level)
	10 % of this	8,5 N to 9 N
	peaks usable for calculation are characterized by	
	rising and falling of force	> 8 N

Bibliography

EN ISO 13934-1:1999, *Textiles - Tensile properties of fabrics – Part 1: Determination of maximum force and elongation at maximum force using strip method (ISO 13934-1:1999)*

EN ISO 13934-2:1999, *Textiles - Tensile properties of fabrics - Part 2: Determination of maximum force using grab method (ISO 13934-2:1999)*

EN ISO 13935-1:1999, *Textiles - Seam tensile properties of fabrics and made-up textile articles - Part 1: Determination of seam maximum force using strip method (ISO 13935-1:1999)*

EN ISO 13935-2:1999, *Textiles - Seam tensile properties of fabrics and made-up textile articles - Part 2: Determination of seam maximum force using grab method (ISO 13935-2:1999)*

prEN ISO 13936, *Textiles - Determination of the slippage resistance of yarns at a seam in woven fabrics (ISO/DIS 13936:1998)*

EN ISO 13937-1:1999, *Textiles - Tear properties of fabrics - Part 1: Determination of tear force using ballistic pendulum method (Elmendorf) (ISO 13937-1:1999)*

EN ISO 13937-2:1999, *Textiles - Tear properties of fabrics - Part 2: Determination of tear force of trouser shaped test specimens (single tear method) (ISO 13937-2:1999)*

EN ISO 13937-3:1999, *Textiles - Tear properties of fabrics - Part 3: Determination of tear force of wing shaped test specimens (single tear method) (ISO 13937-3:1999)*

EN ISO 13937-4:1999, *Textiles - Tear properties of fabrics - Part 4: Determination of tear force of tongue shaped test specimens (double tear test) (ISO 13937-4:1999)*

ISO 4674:1977, *Fabrics coated with rubber or plastics - Determination of tear resistance*

ISO 9073-4:1997, *Textiles - Test methods for nonwovens - Part 4: Determination of tear resistance*

(*Continued from second cover*)

The technical committee has reviewed the provision of the following International Standard referred in this adopted standard and has decided that it is acceptable for use in conjunction with this standard:

International Standard	*Title*
ISO 7500-1 : 2004	Metallic materials — Verification of static uniaxial testing machines — Part 1: Tension/compression testing machines — Verification and calibration of the force-measuring system

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’.

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard alongwith amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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